

Customer No.: 31561
Docket No.: 10958-US-PA
Application No.: 10/604,651

REMARKS

Present Status of the Application

The Office Action rejected claims 40-41 under 35 U.S.C. 112, first paragraph, as failing to comply with the written description. The Office Action rejected claims 1, 12, 20-28 and 40 under 35 U.S.C. 102(e), as being anticipated by Takayama (U.S. 6,610,142). The Office Action also rejected claims 2-11, 13-19 and 41 under 35 U.S.C. 103(a) as being unpatentable over Takayama in view of Jen (JJAP Part 2: Letters 1991, 33(7B), L997-L979) and Luan (J. Appl. Phys. 1990, 68(7), 3445-3450).

Applicants respectfully submit the Examiner may make a mistake for the rejection under 35 U.S.C. 102(e) for claims 1, 12, 20-28 because claim 12 depends to claim 10, but claim 10 is rejected under 35 U.S.C. 103(a).

Applicants have canceled claims 40 and 41. After entry of the foregoing amendments, claims 1-28 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Rejections of 35 U.S.C. 112, first paragraph

The office action rejected claims 40-41 under 35 U.S.C. 112, first paragraph as failing to comply with the written description. Now applicant has canceled claims 40-41.

Rejections of 35 U.S.C 102 (e)

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Applicants respectfully traverse the rejection of claims 1, 10, 20-28 under 35 U.S.C. 102(e) because Takayama (U.S. 6,610,142) does not teach each and every element in the claims.

In order to properly anticipate Applicants' claimed invention under 35 U.S.C 102, each and every element of claim in issue must be found, "either expressly or inherently described, in a single prior art reference". "The identical invention must be shown in as complete details as is contained in the claim. Richardson v. Suzuki Motor Co., 868 F. 2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)." See M.P.E.P. 2131, 8th ed., 2001.

The present invention is in general related to a method of forming a low temperature polysilicon thin film transistor as claims 1 and 10 recite:

Claim 1. A method of forming a low temperature polysilicon thin film transistor, comprising the steps of:

forming an amorphous silicon layer over a substrate;
performing a plasma treatment to the amorphous silicon layer, *wherein the plasma treatment comprises applying an oxygen-containing plasma or applying a hydrogen-containing plasma;*
transforming the amorphous silicon layer into a polysilicon layer;
 patterning the polysilicon layer to form a plurality of island polysilicon layers;
forming a channel region and a doped source/drain region on each side of the channel region in each island polysilicon layer; and
forming a gate over each channel region.

Claim 10. A method of forming a low temperature polysilicon thin film transistor, comprising the steps of:

providing a substrate;
forming an amorphous silicon layer over the substrate;
performing a plasma treatment to the amorphous silicon layer, *wherein the plasma treatment comprises applying an oxygen-containing plasma or applying a hydrogen-containing plasma;*
performing a laser annealing process to transform the amorphous silicon layer into a polysilicon layer;
 patterning the polysilicon layer to form a plurality of island polysilicon layers;
forming a gate insulation layer over the island polysilicon layers;

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forming a channel region in each island polysilicon layer and a doped source/drain region on each side to the channel regions; and
forming a gate over the channel regions.

The Office Action stated Tokayama discloses "nucleation sites are controlled by selectivity exposing the amorphous silicon film to a plasma" in the abstract, second to last sentence, and therefore applicants' argue that in Takayama the plasma treatment is performed to a silicon oxide but not to the amorphous silicon layer is not persuasive. However, applicants have to explain the description of the abstract in the Takayama is incompatible with its detailed description of the invention. Please see col. 4, lines 4-8, "after once exposing the insulator layer to plasma, deposited a layer of amorphous silicon and optically and/or thermally crystallized the amorphous silicon. Thus, it has been found that a silicon semiconductor film deposited on the resulting structure can be crystallized considerably easily" is described. In addition, please see col. 4, lines 33-35, "when the base insulator film is treated with a plasma, a substance which functions as a catalyst for accelerating the crystallization is formed in the insulator" is described. Moreover, please see col. 4, lines 53-55 "the surface of a specimen obtained by depositing an amorphous silicon film on a plasma-treated substrate and thermally treating the resulting structure at 550 .degree. C." is described. In particular, please see col. 8, lines 60-63, "a process for selectively crystallizing an amorphous silicon film by selectively treating the oxide film base using a plasma treatment" is described in Example 2. In addition, please see col. 11, lines 30-65, "a process which comprises selectively crystallizing an amorphous silicon film by

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selectively treating the oxide film base using a plasma treatment..." is described in Example 5. All of the examples and the description in the detailed description of the invention in the citation teach the plasma treatment is performed to the insulator layer or oxide film base, and then the amorphous layer deposited. Therefore, Tokayama fails to disclose the step of performing a plasma treatment to the amorphous layer in the whole detailed description of the invention in the citation. For at least the foregoing reasons, Applicant respectfully submits the sentence "nucleation sites are controlled by selectivity exposing the amorphous silicon film to a plasma" in the abstract of the citation should be typos because there is not any embodiments to support this point. Applicant respectfully submits it should be "nucleation sites are controlled by selectivity exposing the oxide film or the insulator layer to a plasma" in the abstract of the citation because all embodiments and the whole detailed description of the citation only disclose this fact. Hence, Applicant respectfully submits Tokayama fails to disclose, teach or suggest performing a plasma treatment to the amorphous silicon layer, wherein the plasma treatment comprises applying an oxygen-containing plasma or applying a hydrogen-containing plasma as claims 1 and 10 recite.

Furthermore, claim 10 of Tokayama's reference also discloses "depositing said semiconductor film in contact with a catalyst metal which is capable of promoting crystallization thereof; and wherein said catalyst metal is provided by performing a plasma treatment in which said substrate is treated with a plasma produced by utilizing an electrode containing said catalyst metal." Apparently, the plasma treatment is used for providing said catalyst metal for promoting

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crystallization. However, the plasma of claims 1 and 10 of the present application is not used for promoting crystallization.

For at least the foregoing reasons, Applicant respectfully submits that independent claims 1 and 10 patentably define over the prior art reference, and should be allowed. For at least the same reasons, dependent claims 20-28 patentably define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

Rejections of 35 U.S.C 103 (a)

Applicants respectfully traverse the rejection of claims 2-9, 11-19 under 103(a) as being unpatentable over Takayama (U.S. 6,610,142) in view of Jen (JJAP Part 2: Letters 1991, 33(7B), L997-L979) and Luan (Jour. Of Appl. Phys. 1990, 68(7), 3445-3450) because a prima facie case of obviousness has not been established by the Office Action.

To establish a prima facie case of obviousness under 35 U.S.C. 103(a), each of three requirements must be met. First, the reference or references, taken alone or combined, must teach or suggest each and every element in the claims. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skilled in the art, to combine the references in a manner resulting in the claimed invention. Third, a reasonable expectation of success must exist. Moreover, each of the three requirements must "be found in the prior art, and not be based on applicant's disclosure." See M.P.E.P. 2143, 8th ed., February 2003.

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As discussed above, Tokayama fails to disclose, teach or suggest performing a plasma treatment to the amorphous silicon layer, wherein the plasma treatment comprises applying an oxygen-containing plasma or applying a hydrogen-containing plasma. Lurn and Jen also fail to teach or suggest that the amorphous silicon layer is treated by a plasma treatment, wherein the plasma treatment comprises applying an oxygen-containing plasma or applying a hydrogen-containing plasma. In Lurn's reference, the NH₃ plasma treatment is performed to a gate nitride layer. In Jen's reference, the N₂O plasma is used to treat the deposited SiO_xN_y/SiN_x gate insulators. Therefore, both Lurn and Jen fail to teach or suggest that the amorphous silicon layer is treated by a plasma treatment, wherein the plasma treatment comprises applying an oxygen-containing plasma or applying a hydrogen-containing plasma. The three references combined do not teach or suggest each and every element in claims 1 and 10.

The method disclosed by Tokayama is for enabling the crystallization of an amorphous silicon layer within a shorter period time. The NH₃ plasma treatment disclosed by Luan is performed to a gate nitride layer and can cause a general increase in subthreshold slope and threshold voltage of a TFT. The N₂O plasma disclosed by Jen is used to treat the deposited SiO_xN_y/SiN_x gate insulators and can enable the TFT has a smaller threshold voltage. Therefore, the purpose of Tokayama is quite different from that of Luan and Jen. There is not any suggestion, teaching, or motivation that would have led a person of ordinary skill in the art to combine the relevant prior art teachings in the manner claimed.

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For at least the foregoing reasons, a prima facie case of obviousness for claims 1 and 10 has not been established by the Office Action. For at least the same reasons, dependent claims 2-9, 11-19 patently define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

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CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

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Respectfully submitted,

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